

in discharging an insulator is similar to that of points on a conductor.

The remainder of the book is much better than the portion on electrostatics; but there are several errors, and, as usual, the author tries to cover too much ground. When will authors realise that there is no royal road to learning in science or elsewhere? If those who have special aptitude for these studies require years of work to grasp the fundamentals of electricity, is it likely that the "plain man" will get any good from reading 400 "elementary" pages attempting to deal with the whole subject? Such publications only increase the number of persons who talk and write about things of which they imagine themselves masters, but are in reality ignorant.

OUR BOOK SHELF.

Handbook of Flower Pollination, based upon Herman Müller's Work "The Fertilisation of Flowers by Insects." By Dr. P. Knuth. Translated by Prof. J. R. Ainsworth Davis. Vol. ii. Pp. viii+703. (Oxford: Clarendon Press, 1908.) Price 31s. 6d. net.

As stated in our review of the first volume (vol. lxxiv., 1906, p. 605), Knuth's "Handbook of Flower Pollination" is an encyclopædic work, and the second volume, which is now before us, dealing as it does with the various methods of pollination in fifty-six families of dicotyledonous plants, is even more directly a book of reference than the first volume, which was of an introductory nature. In this second volume the author deals seriatim with all the genera and species in the natural orders under consideration, describes the structure of the flowers in so far as it affects directly or indirectly the mode of pollination, and cites the various direct observations on pollination made by himself or others. To each species of plant is appended a list of the insects which have been observed visiting the flowers, together with a statement as to whether the insects in question were devouring or collecting pollen or sucking nectar.

The translator has facilitated the use of the volume, which will be more frequently consulted than read through, by repeating more fully the titles of the books and papers referred to than is the case in the original. Few, if any, of these references are more recent than 1898, the date of publication of vol. ii. in the German edition, though the list of references in the first volume of the translation is brought up to 1904.

No doubt the labour involved in bringing up to date the various recorded visits of insects to flowers would have been very considerable, but on points of a more general character the translator might have added some additional information in the form of footnotes. Thus in dealing with those Papilionaceæ which have so far been recognised as self-sterile, the translator might have mentioned the more recent investigations of Kirchner, and might have referred to the illuminating generalisation of that author, who found that while so many perennial Leguminosæ are self-sterile, all the self-fertile forms of Papilionaceæ are annuals which are dependent for their continued existence on each year's successful crop of seeds, and cannot, therefore, afford to be self-sterile. Similarly, in dealing with the genus *Alchemilla*, mention might have been made of the recent investigations of Strasburger and others on the phenomenon of apogamy so characteristic of a certain section of this genus.

A useful improvement is the addition to the translation of a list of the natural orders dealt with in this volume, which will be as welcome to English readers as the more general introductory volume has proved itself to be.

The Theory of Ions: a Consideration of its Place in Biology and Therapeutics. By Dr. W. Tibbles. Pp. ix+131. (London: Rebman, Ltd., 1908.) Price 2s. 6d. net.

THIS is a bright little book written with the object of pointing out the bearings of physical chemistry on physiological processes. Dr. Tibbles, however, like Pauli, from whose book copious quotations are made, is rather inclined to make the phenomena of ionisation and the behaviour of colloids explain too much. There is no doubt that physical chemistry will in the future make clear a good deal of what is at present obscure in bio-chemistry; but a full appreciation of this effect cannot be gained until two things have occurred; one of these is a settling of the many vexed points of quite a fundamental nature between the physical chemists themselves, and the other is a fuller knowledge of the chemistry of protoplasm in general and of the protein constituents of protoplasm in particular.

At the present day there is probably only one sentence in the book with which all will be in agreement, and that is, "We are far from a satisfactory insight into the nature of the effect of ions."

The author gives a fairly accurate account of the advances recently made in physiological chemistry, although it will probably be found too compressed to appeal to any but those fully up in the subject. His nomenclature is not uniform, and is therefore confusing to the reader; thus he sometimes speaks of proteins, sometimes of proteids; in some places of amino- and in others of amido-acids; there are a number of uncorrected press errors, for instance, glycyl-glycyl for glycyl-glycine. The close similarity of the words absorption and adsorption should have rendered him especially careful in proof-correcting, especially where both are mentioned on the same page. He also gives us the rather startling information that choline is present in bile salts.

The work does not profess to contain anything original; it is rather a compilation from previous writers strung together with the object of emphasising the importance of a knowledge of solutions in the elucidation of physiological, pathological and therapeutical problems. Dr. Tibbles is not always judicious in his selections or judicial in their valuation. For instance, the old theories of Pflüger, Latham, Loew, and others on the distinction between living and dead proteins are all advanced as though they were still tenable and of equal value with the views of Fischer which depend on actual work and not on mere speculation.

Still, the book is interesting, and contains many suggestions of importance, but the author has not realised that it is not possible to write a complete text-book of organic chemistry, bio-chemistry, physical chemistry, therapeutics and immunity within the short compass of 130 small pages, or that the ionic theory or any other theory, however new and attractive, is sufficient to explain the universe.

The Libraries of London: A Guide for Students. Prepared by R. A. Rye. Pp. 90. (London: The University of London, 1908.) Price 6d. net, post free 9d.

THE libraries described in the book, with the exception of those of certain schools of the University, and

that of the Royal Botanic Gardens, Kew, lie within the London County boundary. The information about each of the very large number of London libraries is just what a student wants to assist him in his search for books on a particular subject. Few persons, unless they have made special inquiries, can have any idea of the immense number of books available in London for reference by the seeker after knowledge or recreation. Students owe a debt of gratitude to the Senate of the University of London for giving instructions for the preparation of this guide, and to Mr. Rye for his complete understanding of their needs.

LETTERS TO THE EDITOR.

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The Spectrum of Radium Emanation.

IN NATURE of July 9 a letter from Prof. Rutherford appears giving an excellent corroboration of measurements of the spectrum of radium emanation which we communicated to the Royal Society on July 1. There can, therefore, be no doubt of the accuracy of Prof. Rutherford's measurements. When Mr. Watson, who is engaged in measuring accurately with a 10-foot grating the secondary spectrum of hydrogen, has finished his task, we shall be able to introduce some small corrections in our figures. WILLIAM RAMSAY.

A. T. CAMERON.

University College, Gower Street, London, W.C., July 9.

The Kinetic Energy of the Ions emitted by Hot Bodies.

IN a paper communicated to the American Physical Society at the New York meeting on February 29, the writer, in collaboration with Dr. F. C. Brown, showed that the part of the translational kinetic energy of the negative ions emitted by hot platinum, which depends on their component of velocity normal to the emitting surface, has the same mean value as the corresponding quantity for a molecule of gas at the temperature of the metal, and, further, that that component of the velocity is distributed among the different ions according to Maxwell's law of distribution of velocity among the molecules of a gas. Since then Dr. Brown has succeeded in showing that the same laws hold for the positive ions emitted by hot platinum.

Using a different method, the writer has succeeded in measuring the portion of the kinetic energy of the ions which depends on their component of velocity parallel to the emitting surface. Within the limits of experimental error, this quantity has the same mean value, for both positive and negative ions, as the corresponding quantity for a molecule of gas at the temperature of the metal, and is distributed among the different ions according to Maxwell's law.

Taken together, these investigations show that the ions emitted by hot platinum, under normal conditions, are identical, as regards their kinetic properties, with the molecules of a gas of the same molecular weight, at the temperature of the metal. It follows, by an application of the kinetic theory of gases, that the same thing holds for the free electrons inside the metal. This result has an important bearing on the electron theory of metallic conduction and of the emission of electromagnetic radiation by hot bodies.

This is the first direct experimental confirmation of Maxwell's laws relating to the distribution of velocity among a collection of moving particles in a state of statistical equilibrium.

The full account of these researches will shortly appear in the *Philosophical Magazine*. O. W. RICHARDSON.
Princeton, N.J., July 3.

Absorption of X-Rays.

SOME of the most interesting observations made in the investigation of the properties of homogeneous beams of Röntgen radiation are those exhibiting the connection between the absorption of X-rays and the emission of secondary X-rays from the absorbing substance. Many elements—probably all—when subject to a suitable primary beam, are the source of a homogeneous Röntgen radiation which is characteristic of the element emitting it. The following conclusions concerning the emission of this radiation have been found to be perfectly general, so far as experiments have been made.

When a very absorbable primary radiation is incident on a given element, the homogeneous radiation characteristic of that element is not emitted in appreciable intensity.

As the general penetrating power of the primary radiation is gradually increased, the absorption decreases only up to a certain point. When the penetrating power becomes greater than that of the radiation characteristic of the absorbing element, the absorption of that primary radiation begins to increase, and a secondary homogeneous radiation begins to be emitted. Then there is a rapid and considerable increase in both the absorption of the primary rays and in the emission of secondary rays. When the general penetrating power is increased still further, the absorption decreases again in the usual way, and the intensity of secondary radiation decreases at the same rate—in some cases at least—as the ionisation produced by the primary beam in air.

The special absorption of the primary rays thus connected with the emission of secondary rays is a considerable fraction of the total absorption—thus in iron the increase is about double the absorption previous to the emission of the rays.

Experiments have not been made to determine if all the extra energy absorbed appears as energy of secondary radiation, but from observations of the absorbability of the secondary radiation and of the ionisation it produces, it appears probable that a large proportion is re-emitted.

The energy re-emitted in the form of a radiation of more absorbable type is in some cases sufficient to make the total ionisation produced in an electroscope placed immediately behind a thin absorbing sheet of metal greater than that produced by the direct unabsorbed primary beam.

The emergent radiation is then a mixture of two homogeneous radiations, the proportions of which depend principally on the coefficients of absorption of the incident radiation, and of the radiation characteristic of the metal in the metal itself, the coefficient of transformation of one into the other type of radiation, and the thickness of the absorbing plate. A copper radiation may, by transmission through an iron plate, be transformed so completely as to be almost indistinguishable from pure iron radiation, but it does not then proceed in the direction of propagation of the incident radiation; it is emitted from the atoms in approximately equal intensity in all directions.

What has previously been described as the special power of a homogeneous radiation of penetrating the element emitting it and elements of neighbouring atomic weight (*Phil. Mag.*, September, 1907, p. 408) may be more precisely stated thus:—A radiation which is more absorbable, equally absorbable, or only slightly more penetrating to most substances than the radiation characteristic of the element upon which it is incident, is absorbed much less than one of more penetrating type. It also produces little or none of the characteristic secondary radiation which is produced by the more penetrating radiation.

The special power of an ordinary heterogeneous primary radiation after transmission through an absorbing substance of penetrating further layers of that substance is due to two causes—(1) the special absorption of those radiations capable of stimulating a homogeneous secondary radiation, (2) the superposition on the primary radiation of that secondary radiation.

A full account of these experiments and a discussion of the results will be published shortly. C. G. BARKLA.
Liverpool, July 8. C. A. SADLER.